CLAIMS:

1. A method of cryogenically cooling a superconducting magnet surrounded by liquid helium at a temperature of below 4.2 K within an inner chamber of a cryogenic vessel, the method comprising:

supplying current to the magnet by way of a supply passage extending through the wall of the vessel in order to initiate superconducting current flow in the magnet,

stopping the supply of current to the magnet whilst the superconducting current flow persists in the magnet,

after an extended period of superconducting current flow in the magnet and without stopping such superconducting current flow, supplying liquid helium at a temperature of about 4.2 K to an upper part of the inner chamber above the magnet such that the magnet is still surrounded by liquid helium at a temperature of below 4.2 K,

stopping the supply of liquid helium to the inner chamber, and

cooling the liquid helium in the upper part of the inner chamber to a temperature of below 4.2 K.

2. A method according to claim 1, wherein the magnet is cooled by the liquid helium within the inner chamber to a temperature of below 2.5 K.

3. A method according to claim 2, wherein the magnet is cooled by the liquid helium within the inner chamber down to a temperature below the lambda point (2.17 K).

4. A method according to claim 1, 2 or 3, wherein the liquid helium at a temperature of below 4.2 K is supplied to the inner chamber by way of a valve.

5. A method according to any preceding claim, wherein the liquid helium at a temperature of below 4.2 K is supplied to the inner chamber by way of a valve having a removable actuating shaft, and the actuating shaft is removed from the valve after the supply of liquid helium to the inner chamber has stopped, in order to limit heat conduction during further operation.

6. A method according to any preceding claim, wherein the current is supplied to the magnet by way of a removable current lead having a connector part at one end adapted (i) to be connected to a connector part provided on the magnet internally of the inner chamber in order to supply current from an external current source to the magnet by way of the lead extending through the supply passage, and (ii) to be subsequently detachable from the connector part to permit withdrawal of the lead from the supply passage so as to limit heat conduction along the supply passage during further operation.

7. A method according to claim 6, wherein the inner chamber is vented with helium gas without warming the liquid helium within the inner chamber to any substantial extent to permit the lead to be withdrawn from the supply passage.

8. A method according to any preceding claim, wherein the level of the liquid helium in the inner chamber is monitored during operation so as to provide an indication of the need to supply liquid helium at a temperature of about 4.2 K to the upper part of the inner chamber when the level of the liquid helium in the inner chamber has fallen below a predetermined level.

9. A method according to any one of claims 1 to 8, wherein the magnet is annular and is disposed with its axis horizontal within a horizontal cryogenic vessel.

10. A method according to claim 9, wherein the liquid helium at a temperature of about 4.2 K is supplied to the upper part of the inner chamber from a source of liquid helium that is external to the cryogenic vessel.

11. A method according to any one of claims 1 to 8, wherein the magnet is annular and is disposed with its axis vertical within a vertical cryogenic vessel.

12. A method according to claim 11, wherein the liquid helium at a temperature of about 4.2 K is supplied to the upper part of the inner chamber from an outer chamber surrounding the inner chamber and contained within the cryogenic vessel.

13. A superconducting magnet system comprising:

a cryogenic vessel,

a superconducting magnet contained in an inner chamber within the vessel to be cooled by liquid helium at a temperature of below 4.2 K within the inner chamber,

current supply means for supplying current to the magnet by way of a supply passage extending through the wall of the vessel in order to initiate superconducting current flow in the magnet, and for subsequently stopping the supply of current to the magnet whilst the superconducting current flow persists in the magnet,

liquid helium supply means for supplying, after an extended period of superconducting current flow in the magnet and without stopping such superconducting current flow, liquid helium at a temperature of about 4.2 K to an upper part of the inner chamber above the magnet such that the magnet is still surrounded by liquid helium at a temperature of below 4.2 K, and for subsequently stopping the supply of liquid helium to the inner chamber, and

cooling means for cooling the liquid helium in the upper part of the inner chamber to a temperature of below 4.2 K.

14. A system according to claim 13, wherein the liquid helium supply means comprises a valve.

15. A system according to claim 14, wherein the valve has a removable actuating shaft, the actuating shaft being removable from the valve after the supply of liquid helium to the inner chamber has stopped in order to limit heat conduction during further operation.

16. A system according to claim 13, 14 or 15, wherein the current supply means is in the form of a removable current lead having a connector part at one end that is adapted (i) to be connected to a connector part provided on the magnet internally of the

inner chamber in order to supply current from an external current source to the magnet by way of the lead extending through the supply passage to initiate superconducting current flow in the magnet, and (ii) to be subsequently detachable from the connector part, with the superconducting current flow persisting in the magnet, to permit withdrawal of the lead from the supply passage so as to limit heat conduction along the supply passage during further operation of the system.

17. A system according to claim 16, wherein venting means is provided for venting the inner chamber with helium gas without warming the liquid helium within the inner chamber to any substantial extent to permit the lead to be withdrawn from the supply passage.

18. A system according to any one of claims 13 to 17, wherein monitoring means is provided for monitoring the level of the liquid helium in the inner chamber during operation so as to provide an indication of the need to supply liquid helium at a temperature of about 4.2 K to the upper part of the inner chamber when the level of the liquid helium in the inner chamber has fallen below a predetermined level.

19. A system according to any one of claims 13 to 18, wherein the magnet is annular and is disposed with its axis horizontal within a horizontal cryogenic vessel.

20. A system according to claim 19, wherein the liquid helium supply means includes a source of liquid helium external to the cryogenic vessel.

21. A system according to any one of claims 13 to 18, wherein the magnet is annular and is disposed with its axis vertical within a vertical cryogenic vessel.

22. A system according to claim 21, wherein the liquid helium supply means includes an outer chamber containing liquid helium at a temperature of about 4.2 K, the outer chamber surrounding the inner chamber and being contained within the cryogenic vessel.

23. A system according to any one of claims 13 to 22, wherein a gas-cooled shield is provided within the vessel so as to surround the inner chamber.

24. A system according to any one of claims 13 to 23, wherein an annular liquid nitrogen reservoir is provided within the vessel so as to surround the inner chamber.

25. A superconducting magnet system comprising a cryogenic vessel, a superconducting magnet contained in an inner chamber within the vessel to be cooled by liquid helium within the inner chamber, and liquid helium supply means for supplying liquid helium to the inner chamber and for subsequently stopping supply of liquid helium to the inner chamber, wherein the liquid helium supply means incorporates a removable actuating shaft, the actuating shaft being removable after the supply of liquid helium to the inner chamber has stopped in order to limit heat conduction during further operation.

26. A superconducting magnet system comprising a cryogenic vessel, a superconducting magnet contained in an inner chamber within the vessel to be cooled by liquid helium within the inner chamber, and supply means for supplying current to the magnet by way of a supply passage extending through the wall of the vessel in order to initiate superconducting current flow in the magnet, wherein the supply means is in the form of a lead having a connector part at one end that is adapted (i) to be connected to a connector part provided on the magnet internally of the chamber in order to supply current from an external current source to the magnet by way of the lead extending through the supply passage to initiate superconducting current flow in the magnet, and (ii) to be subsequently detachable from the connector part, with the superconducting current flow persisting in the magnet, to permit withdrawal of the lead from the supply passage so as to limit heat conduction along the supply passage during further operation of the system.